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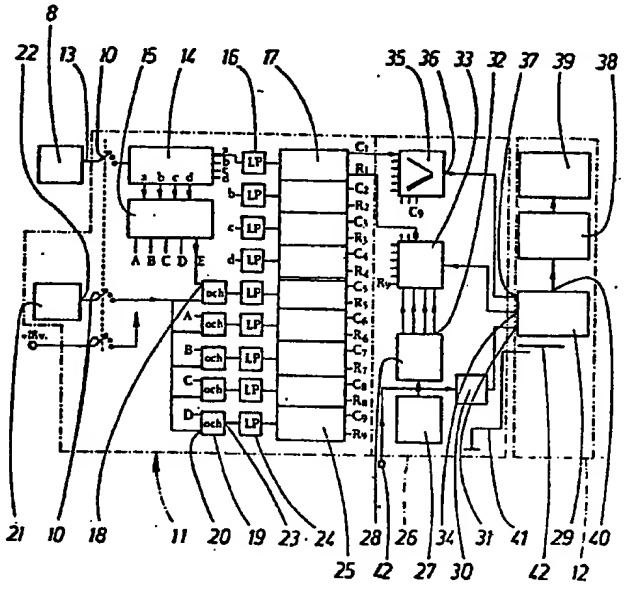

(57) Abstract

A device for registration of motions or positions of a body (7) or a body includes at least one sensor unit (8) which is to be attached to the body or body portion intended to be registered. A registration unit (11) divides the measuring interval into a number of partial intervals and registers information about the body motions. The number of occasions is indicated, in which the motion or position of the body is located within each partial interval and about the duration for this motion or this position in each separate partial interval. By means of a reading unit (12, 26) the registered information can be read.

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Title:

Device for registration of motions or positions of a body or a body portion

Technical field:

The present invention relates to a device for registration of motions or positions of a body or a body portion comprising at least one sensor unit which is arranged to be attached to the body or body portion intended to be registered and to emit a sensor signal within a predetermined measuring interval dependant on the motion and/or position of the actual body or body portion.

Background:

For the registration of body motions there is present a plurality of prior known solutions of this problem. For example, a registration of motion may be performed by the aid of high-frequency filming, the performance of which might be suitable when there is no intention to use quantitative estimation but only a simple description of motion. A possible estimation is namely very time-consuming dependant upon the fact that each film check is to be estimated individually, which involves a plurality of measuring points before the collection of data and calculations could be obtained. This type of registration of motion is further less suitable for registration of motion applied to working places as the desired equipment requires certain arrangements of space-consuming devices and the working motions are strongly limited to a predetermined space. Another kind of registration of technics is built on the opto-electronics with an infra-red camera which detects a number of infra-red rays transmitted from luminous diodes applied to certain points of the object of measuring. This kind of technics requires a relatively complicated arrangement of points and that a free space is disposable between the camera and the person intended to be measured. This method is therefore not suitable to be used for measurements at working places. Furthermore, it is known to use registration of motion by so called goniometric technics. This means, for studying the body motion a suitable motion sensor is designed including fastening devices, for example a goniometer. The sensor emits an electrical or possibly

mechanical signal which is proportional to the position of the goniometer. The present invention relates to the last mentioned kind of technics which, by solutions hitherto known has resulted in a very great quantity of unwieldy information which afterwards requires a time-consuming work of estimation.

Technical problem:

The object of the present invention is to provide a device for registration of motions which is specially adapted for measuring body motions at working places and performs a simply estimated description of the motion pattern by a suitably performed data reduction.

The solution:

Said object is obtained by means of a device which is characterized by the device including a registration unit which is arranged to divide said measuring interval into a number of partial intervals and to register information partly about the number of occasions, in which the motion and/or position of the body or the body portion is located within each partial interval and partly about the duration for this motion or this position in each separate partial interval, and at least one reading unit by means of which the registered information can be read.

Brief description of drawings:

The invention will be described hereinafter by an embodiment with reference to the accompanying drawings in which Fig. 1 shows by way of example the practical outer performance of a device in accordance with the invention and Fig. 2 shows by means of a block diagram an embodiment of the electrical performance of the device according to the invention.

Best mode of carrying out the invention:

In Fig. 1 a device for registration of motion in accordance with the invention is shown which in the related example is especially intended for the registration of motions of the back portion of the body. For this purpose the device according to the invention is provided with a portable registration unit 11 (vide Fig. 2) mounted into

an apparatus box 1. This is fixed to the back portion 2 of a waistcoat shaped harness 3, made of textiles, plastics or the like, intended to be attached to the back of a person, the motions of whom have to be registered. The harness 3 consists of a waist belt 4 and two each other crossed breast belts 5. Each of the belts is provided with buckles 6, by means of which the belts may be released or be stretched in order to fit different dimensions of the person in question, hereinafter for the sake of simplicity called the person to be measured and indicated by reference numeral 7.

The device for registration of motions according to the invention is especially adapted to be used in measurements of working motions performed by working persons. In this case the device in accordance with the invention is accompanying in the working motions of the person and catches information of the these motions, the information of which can be read and estimated in a very easily available way which will be described more closely hereinafter. The device is mainly built on a conversion of the back motions of a working person to electrical signals which are converted to information which can be estimated. The example in Fig. 1 shows a position sensor 8 attached on the outside of the apparatus box 1, said sensor being in the form of a so called goniometer or a pendulum galvanometer, showing a pendulum pivotally journalled in the position sensor, the position of the pendulum being indicated in relation to the portion of the position sensor fixed to the apparatus box 1. Further a unit for current supply 9 is attached to the outside of the apparatus box 1 in the form of two 9 V transistor batteries connected in series. Furthermore, to the outside of the apparatus box 1 a triple pole switch 10 is attached, having three positions more closely described hereinafter. Besides the registration unit 11 a first reading unit 26 is mounted in the apparatus box 1. The installation of these units is shown in Fig. 2. Besides the units 11, 26 built into the apparatus box 1, the device comprises a second reading unit 12 which is connectable to the first reading unit 26 for reading information registered in the registration unit 11 regarding the pattern of motion. Also the principal installation of the second reading unit 12 is shown in Fig. 2. This is thus advantageously a separate unit to which a plurality of the other units of the device are connected.

The separate reading unit 12 may by way of example consist of a commercially available device. As an example it may be referred to a unit manufactured by Electroline AB, Stockholm, model No. EN 506 A.

In the embodiment shown in Fig. 2 the position sensor 8 comprises an analog goniometer with a measuring range of 90°, for example directed in such a manner that according to current orthopaedic nomenclature of goniometry, the motions are measured from 9° backwards to 81° forward, i.e. from -9° to +81°. At the output 13 of the goniometer a sensor signal appears, which for example consists of an electric voltage which is proportional to the angular position of the position sensor 8 relatively to a fixed ground connected system of coordinates and for example relatively to a vertical plane placed transversely to the principal back motion of the person to be measured. In the embodiment shown thus only bending motion in a plane perpenducular to a vertical plane placed against above mentioned vertical plane is disclosed. The position sensor 8 is via the switch 10 connected to a level detector 14. This one is divided into a number of in the shown embodiment five, equal partial intervals into which the 90°-interval is divided. Each of the partial intervals corresponds to five outlets A, B, C, D, E from a code convertor 15 which is connected to four outlets a, b, c, d, e from the level detector 14. Thus an output signal appears at that one of the five outlets A, B, C, D, E corresponding to that partial interval in which the position sensor is positioned for a certain moment. From the level detector 14 signals are emitted at the outlets a, b, c, d when the different interval limits are passed in one direction.

Each of the outlets a, b, c, d is via a low pass filter 16 for each outlet connected to a pulse register 17 for limit passage. For each interval limit there is thus a pulse register 17 and thus a pulse appears for each limit passage in one direction, i.e. for example at transition from one partial interval to another but not at return from last mentioned partial interval, i.e. at limit passage in opposite direction. Each of the pulse registers is designed to count the number of pulses appearing at the outlet adherent to it i.e. the number of limit passages in one direction. The low pass filters 16 serve as disturbance filters for the pulse registers which are sensible in this aspect. Each of the outlets A, B, C, D, E from the code converter

15 is connected to one inlet 18 of an AND-circuit 19 arranged for each outlet in the embodiment shown, thus five AND-circuits are arranged. To the second inlet 20 of each AND-circuit 19 is via the mentioned triple-pole switch 10 a clock pulse generator 21 connected, which at its outlet 22 is arranged to emit clock pulses which are used as time information. The clock pulse generator 21 produces for example ten pulses per second which means that the dissolution of the time will be a tenth of a second. The choice of dissolution is a compromise between total time of registration and minimum of time in an interval. The outlet 23 from each of the AND-circuits 19 is via a low pass filter 24 connected to a time register 25, i.e. in the embodiment shown there are five registers arranged and more precisely one time register for each of the outlets A, B, C, D, E, i.e. for each partial interval. A signal appears, as mentioned above, at that outlet A, B, C, D, E which corresponds to that angular interval in which the position sensor 8 is located. This signal is thus fed to one of the inlets 18 to the AND-circuit in question whereby the same is opened and the clock pulses from the clock pulse generator 21 are gated via connected low pass filter 24 to the time register 25 belonging thereto, counting the number of arriving pulses and thus measuring the time during which the position sensor 8 is located at a certain interval. The time registers are mutually excluding which means that, when one time register is counting, it is not possible that any of the others is able to count. The total time of registration may be obtained as the sum of the pulses of all the time registers. The pulse register 17 as well as the time register 25 may be used in the form of same digital register in which for example the information is stored in 20 bits, which is enough for 10 millions of pulses. Digital technics is used throughout the device according to the invention except for the position sensor 8 and thus the in-coming signal to the level detector 14. For example, digital circuits of the so called CMOS-type are chosen which are very current-saving.

In the pulse registers 17 and the time registers 25 thus information is stored regarding partly the number of limit passages between the different partial intervals and partly the time during which the position sensor is located in a certain partial interval. Thus, in order to read this information the second reading unit is present

besides of the reading unit arranged to be connected to the registration unit 11 at the time for estimation. This second unit is provided with a push button 27 which is connected to a decade counter 28 which is arranged to take ten positions and to change between these positions by the aid of the push button. The push button 27 is also arranged to be connected to the separate reading unit 12 and more in detail to an oscillator 29 located in said unit and transferred thereto via a delay lead 30. The delay lead 30 is intended to prevent interferences appearing in the second estimation unit 12. The push button 27 is namely via said delay lead 30 connected to a start inlet 31 to the oscillator 29 whereby possible interferences are eliminated by a delayed starting of the oscillator after that the push button is actuated. The decade counter 28 with its outlets 32 is connected to a decoder 33 which is adapted to receive pulses from the outlet 34 of the oscillator 29. The decoder 33 is connected to each of the pulse registers 17 and the time registers 25 and more in detail to inlets indicated R_1 to R_9. Outlets C_1 to C_9 are connected to an overflow meter 35 in the form of a code converter, the outlet 36 of which is connected to a stop inlet 37 of the oscillator 29 in the separate reading unit 12. In this is also included a register 38 and a numerical display 39 which is arranged to display numerical information dependant on the number of pulses given from the outlet 40 of the oscillator 29.

The reading functions in that way that the pulse registers 17 as well as the time registers 25 are stored to maximal capacity whereby a special overflow pulse is obtained which is used to stop the oscillator 29 of the reading unit 12. The frequency of the oscillator is for example 120 kHz which results in the fact that it takes ten seconds to fill up a register which is almost empty. By subtracting the number of pulses necessary to give a register total capacity from this total capacity, information about the number of pulses counted by each register during the measurement is obtained by means of the push button 27, the different positions of the decade counter is chosen, one position of which, for example the zero-position results in maximal registration capacity of the four positions result in reading of each of the four pulse registers 17 and the other five positions result in reading of each of the five time regis-

ters 25. By means of the push button 27 and the decade counter 28 the pulse register 17 or time register 25 is chosen which is stored with pulses from the outlet 34 of the oscillator 29 until the actual register is full. Thereby an overflow pulse is obtained from the outlet C_1 - C_9 of the filled up register to the inlet of the over flow meter 35 in question. When the register is fully stored a signal is transferred to the stop inlet 37 of the oscillator 29 whereby the oscillator is stopped and the counting upwards in the numerical display initiated by the push button 37 is stopped. The presented numerical value is indicated whereafter a new reading is performed from another register, chosen by pushing the button 27. Every time a reading is performed the registers are automatically set to zero. By numeral 41 a ground connection is indicated which via a contact 42 is to be connected to the ground connection of the separate reading unit 12.

A registration of the back motions and more in detail the bending motions of a person, for example the back motion of said person when working is brought out as follows. The person fastens the harness 3 with the apparatus box 1 fixed thereto. Said box and the position sensor 8 attached thereto is always following the bending motions of the back and thus registers and measures the different motions of the spinal column in direction forwards and backwards. This is obtained owing to the fact that information is stored during a certain measuring period regarding the number of and duration of said back bendings to predetermined angular intervals. This is obtained in that way that the pulse registers 17 count the number of times the different angular intervals are passed in one direction while the time registers 25 measure that time during which the position indicator 8 is located in each of these angular intervals. At lifting work these measurements are preferably combined with a separate registration of the load which the back is exposed to and this is in a simple way performed by registration of the weight of the object to be lifted. When the measuring period is finished, the device is switched off by the switch 10 or, if reading is to be made immediately, the switch 18 is switched to its intermediate position, i.e. "standby-position". In this position the feed voltage is switched to the different circuits while the position indicator 8 is switched

off so that the level selector 14 is not sensing any sensor signal. The reading is performed as mentioned above in such a way that the separate reading unit 12 is connected to the first reading unit 26 in the apparatus box, whereafter the reading is performed as mentioned above. This means that the information in each of the pulse registers 17 and the time registers 25 is transmitted to the numerical display 39 which is to be read and the measuring result is noted. As mentioned above the exact registration time can be obtained by governing the decade counter 28 by means of the push button 27 whereby the sum of the time registered in the time registers 25 is obtained. The reading may also be performed by means of external control for example a micro computer unit is connected to a connection 42 adapted to store the read information and also to have it written in legible text on paper when desired by a printing apparatus. Thus it is possible to obtain tabulated information which is well adapted for a direct estimation. An example for such an information is: During the registration time fifteen back bendings have been performed at an angle up to 15°, twenty back bendings at an angle up to 15°-30°, ten back bendings at the angle 30° - 45°. The back bendings in the first group have been performed during 15 seconds, three back bendings during 20 seconds and so on.

The invention is not limited to the embodiment above described and shown in the drawings but could be varied within the scope of the following claims. It is, for example, possible that other body motions than back bendings might be measured. Further, it is possible that bendings are sensed not only in one plane but also in other planes, such as lateral bendings which require a more combined position sensor or more position sensors and a correspondingly multiplication of some of the included circuits. Further, it is possible that other sensors than position sensors can be used such as acceleration sensors or sensors for sensing the size, direction and/or velocity of a motion. The sensor signal can have a frequency variating to the angular position of the position sensor instead of a variating voltage. The position sensor can also be arranged to sense torsional motions for example around an axle extending in the longitudinal direction of the spinal column. The reading units can be integrated to one single unit which can be separated from the regis-

tration unit or mounted together with the same. In some special cases it is possible that there is only one interval in which the number of motions is measured.

Claims:

1. Device for registration of motions or positions of a body (7) or a body portion comprising at least one sensor unit (8) which is arranged to be attached to the body or body portion intended to be registered and to emit a sensor signal within a predetermined measuring interval dependant on the motion and/or position of the actual body or body portion, CHARACTERIZED BY the device including a registration unit (11) which is arranged to divide said measuring interval into a number of partial intervals and to register information partly about the number of occasions, in which the motion and/or position of the body or the body portion is located within each partial interval and partly about the duration for this motion or this position in each separate partial interval and at least one reading unit (12, 26) by means of which the registered information can be read.

2. Device according to claim 1, CHARACTERIZED BY the sensor (8) consisting of at least one position sensor the sensor signal of which is proportional to the angular position sensed by the position sensor and the registration unit (11) including partly a level detector (14) arranged to create a first output signal indicating that partial interval in which the motion or the position is located for every special moment and a second output signal for every transition from a partial interval to another partial interval in one direction and partly a unit arranged to create information of the duration of the first mentioned output signal, and partly a memory unit (17, 25) arranged to accumulate informatin about the duration of the motion or the position in each partial interval and information about the number of transitions between each partial interval.

3. Device according to claim 2, CHARACTERIZED BY the mentioned memory unit consisting of partly a pulse register (17) arranged for each partial interval and partly a time register (25) arranged for each transition between the partial intervals.

4. Device according to claim 3, CHARACTERIZED BY the estimation unit (12, 26) being arranged to fill the pulse registers (17) and the time registers (25) one by one to full capacity with pulses, the accumulated information in each register being registered by counting the number of pulses required for filling up and subtrac-

ting from the number of pulses corresponding to full capacity, whereafter the result is presented.

5. Device according to claim 4, CHARACTERIZED BY the reading unit (12) including a decade counter (28) arranged to be governed between its different positions, and an oscillator (29) arranged to emit pulses for filling the pulse registers (17) and the time registers (25), the decade counter (28) being arranged, dependent on its located position, to feed pulses to a certain register, which for the moment is to be read.

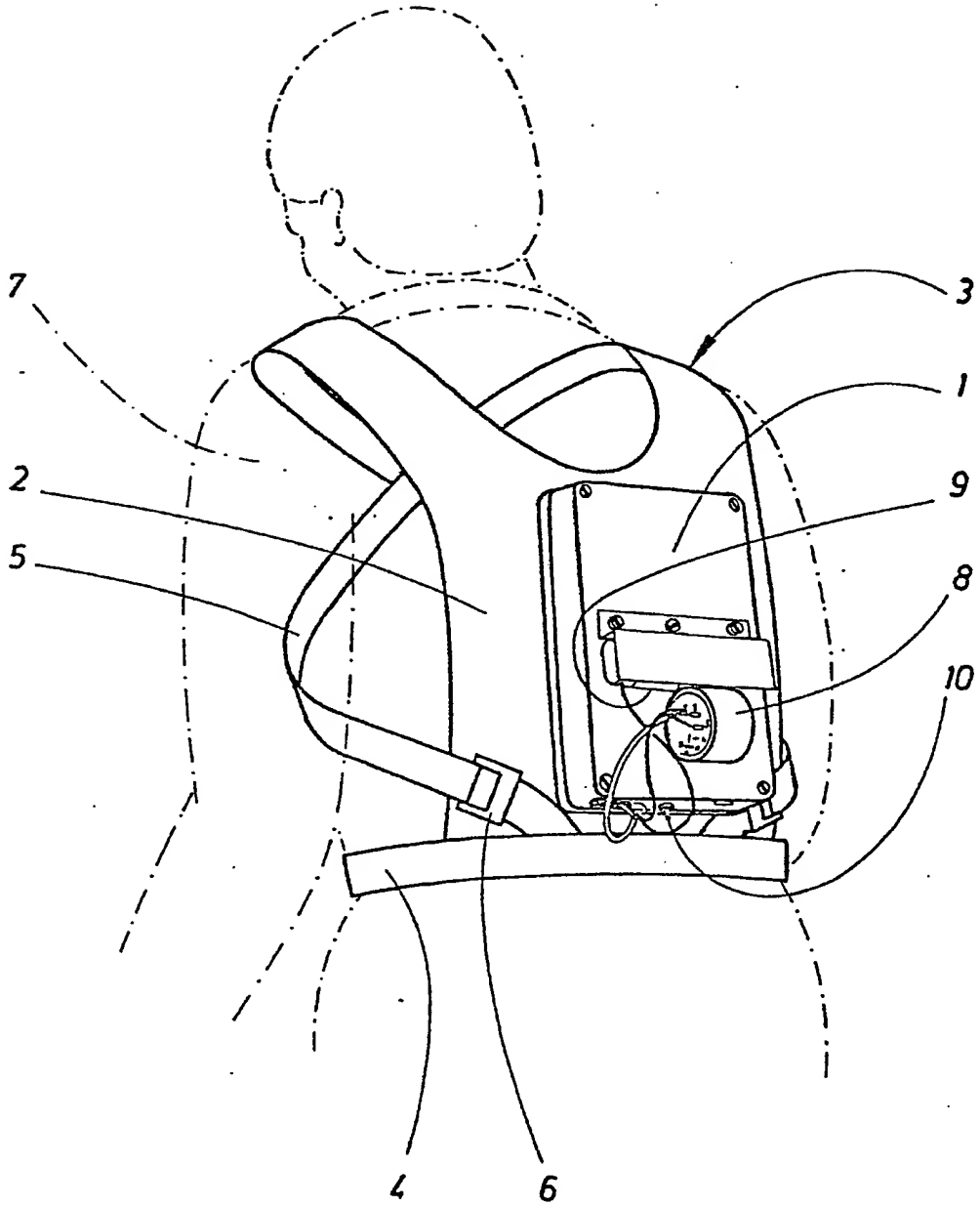

FIG. 1